Proposal to Delist

San Lorenzo River Lagoon

for Siltation

California Regional Water Quality Control Board
Central Coast Region

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Background

The San Lorenzo River Estuary and the San Lorenzo River have been listed for non-attainment of established water quality standards pertaining to sediment under Section 303(d) of the Clean Water Act. Three creeks within the San Lorenzo River Watershed have also been listed. These are Shingle Mill Creek, Lompico Creek and Carbonera Creek. Section 303(d) requires the State to establish the Total Maximum Daily Load (TMDL) for sediment at a level necessary to achieve/attain the water quality standard for sediment. Seasonal variations and a margin of safety that takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality must be incorporated into the TMDL.

The following watershed characterization is from a State Water Resources Control Board draft staff report (SWRCB, 1982, pgs. 12-13):

"The San Lorenzo River drains an area of 138 square miles in northern Santa Cruz County. The river flows southward to empty into Monterey Bay at the City of Santa Cruz (Figure 1). Much of the watershed is rugged and forested as is typical of the Coast Range south of San Francisco.

"Elevations range from sea level to above 3,000 feet within the San Lorenzo River Watershed. The river drops from an elevation 2,900 feet to sea level in 22 miles, dropping the first 2,000 feet in only 3 miles. Most of the tributaries enter the river from the east where the drainage area is underlain with sedimentary rocks. Major tributaries from the east include Branciforte, Carbonera, Zayante, Newell and Bear Creeks. Boulder and Fall Creeks are the two major streams that drain the western portion of the watershed that is underlain by granitic rock.

"The climate of the watershed is affected by its proximity to the Pacific Ocean. Winters are cool and wet with an average annual rainfall of about 47 inches, ranging from about 30 inches in the City of Santa Cruz to 60 inches at the community of Boulder Creek. Summers are warm and dry although cooled at times by morning fog at the lower elevations. Eighty-two percent of the rainfall occurs in the period December through April.

"Highway 17 from Santa Cruz to San Jose follows the western border of the watershed. Highway 9 from Santa Cruz to Santa Clara generally follows the San Lorenzo River northward. Communities important to the watershed include Scotts Valley, Felton and Boulder Creek.

"Human use of the watershed followed a pattern similar to other areas of the Coast Range within 100 miles of San Francisco Bay. In the early 1800's, the coastal grasslands supported cattle that were a source of hides and tallow. During the 1860 to 1900 period, logging was a major activity. In 1864, 28 sawmills were operating in the Big Basin- San Lorenzo Valley (SCCPD, 1979, secondary reference). Although redwood and fir were the principal species sought as lumber, many areas were clear-cut so that other species of trees were cut and later burned in the process.

"Although some forest and brush areas were converted to agricultural land in the late 1800's and early 1900's, agriculture has not remained an important use in the watershed. Limestone supported an important industry for a time and there were a number of sand and gravel quarries.

"In the mid-1800's, the beach at Santa Cruz and the redwood forests became an important attraction for people from the San Francisco Bay area. Many second-home developments began in the period between 1900 and 1925. This use increased and many of the small communities were well

established prior to 1940. In the 1950's the San Lorenzo River was considered a "well-developed resort and recreational area (Smith, 1958, secondary reference)." Much of the watershed, though, consisted of summer homes. In 1960, the vacancy rate for the watershed was 56 percent, while the population at the time was 10,946 (Ricker, 1976, secondary reference). In the 1960's many of the summer homes were converted to year- round residences. A number of major subdivisions were authorized and many residences were built for year-round occupancy. By 1976, many summer homes were converted to permanent residences, and the vacancy rate decreased to 21 percent, while the population rose to 30,538 (Ricker, 1976, secondary reference). Between 1960 and 1976, the number of housing units in the watershed increased from 8,982 to 14,131, a 57.3 percent increase (SCCPD, 1979, secondary reference). Most of the new development during this period was along the flat valley bottom along the streams and it was estimated that 14 percent of the homes in the watershed were within 100 feet of the San Lorenzo River or one of its tributaries (SCCPD, 1979, secondary reference)."

The following is from a Central Coast Regional Board Report (Jagger, 1993, pg.12-13):

"Coats (1982, secondary reference) asserted that land-use activities, including road and homesite construction, significantly increased the sediment yields in Zayante Creek and San Lorenzo River. Observations of Zayante and Lockhart Creeks by Coats (1982, secondary reference) showed that although the head and middle waters of these creeks had the same steep slopes and bedrock composition, the sediment yield was higher in the mid-basin regions, possibly because "land use has been more intense in mid-basin areas (Coats, 1982, secondary reference). Estimates on the extent of induced erosion ranged from two to four times the amount of natural erosion (SCCPD, 1979, secondary reference). The same source noted that 90 percent of landslides observed in the winter of 1978 were triggered by human disturbances. SWRCB (1982, secondary reference) stated that over 25 percent of the induced sedimentation of the San Lorenzo River was attributed to recent construction, with another 35 percent of the sedimentation blamed on erosion from unimproved paved roads. Coats (1982, secondary reference) stated that 80 percent of the induced erosion was from road construction. The County Resources Inventory Map (SCS, 1990, secondary reference) stated that impairment of Bean, Bear, Boulder, Kings, Lompico, Newell, and Zayante Creeks resulted directly from construction or development."

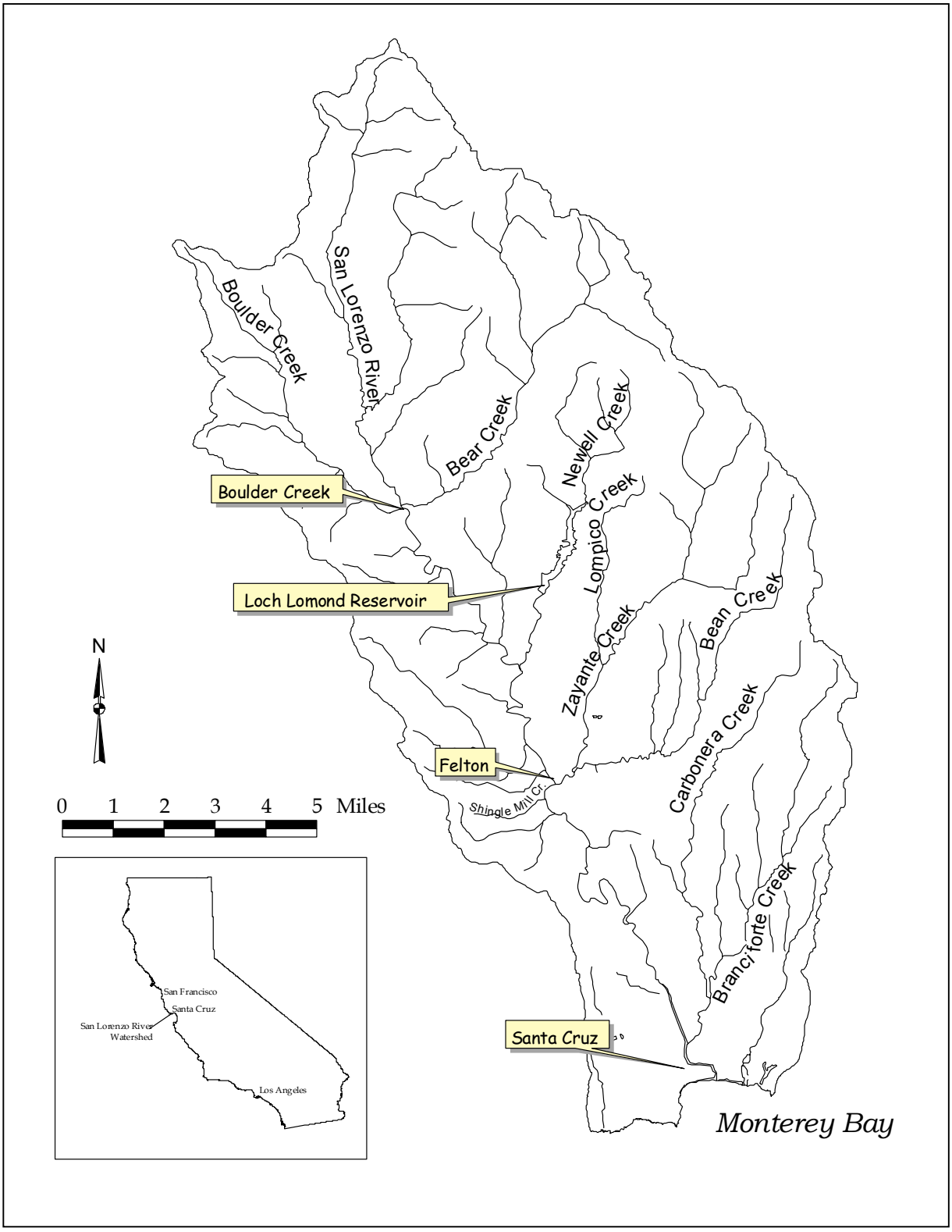

Figure 1 San Lorenzo River Watershed

Construction activity is not as prevalent today, in 2001, as it was in the 1970's and 1980's. County data indicates that construction activity peaked in the watershed in the 1970's and 1980's and has since decreased (Reference Figure 2 below). Therefore, construction has not been identified as a separate sediment source category. It is included in the Other Urban and Rural Lands sediment source category. Current construction trends are towards single home development on large parcels. The access roads associated with this type of development are proving to be problematic and are addressed within the appropriate Roads Sediment Category.

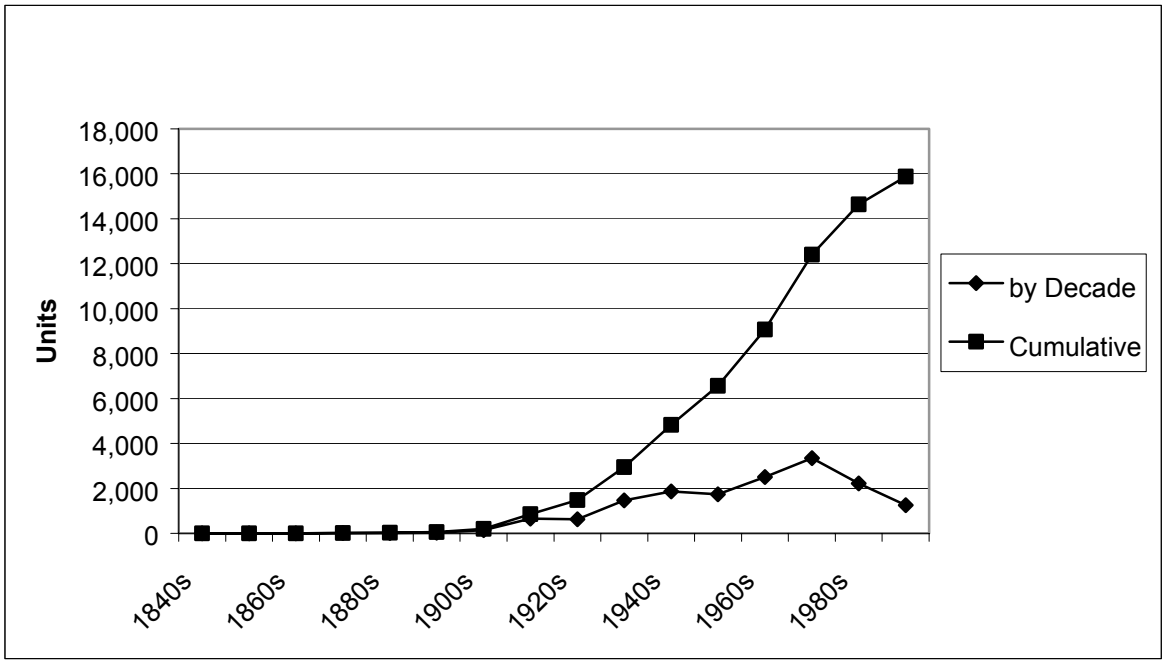

Figure 2 Construction Activity in San Lorenzo River Watershed

The dominant cause of disturbance remains the extensive road network (Hecht, 1998, pg. 37-38). Unpaved and poorly maintained roads that are used for year-round access continue to be the most persistent sources of bed sedimentation. Increasing use and disturbance of the roadway surfaces as well as inadequate roadway drainage appear to be the primary immediate sources. Numerous small-scale failures of cut and fill slopes and culvert blowouts also introduce much debris along roads. Sidecasting of storm debris during road maintenance contributes to stream sedimentation. Road drainage practices accelerate flow to and within headwater creeks induce considerable road-related erosion downstream from the right-of-way. The connection between road construction/maintenance and culvert blowouts and eroding banks downstream is often not perceived or appreciated.

Improved maintenance of existing roads is likely to prove one of the most effective means of reducing sedimentation and persistent turbidity in the San Lorenzo River Watershed. In this context, roads include those maintained by the County, State, road associations, and private owners (including those used for timber harvest and fire control).

Problem Statement

The waterbodies that have been listed for sediment in the San Lorenzo River Watershed are: the Main Stem of the San Lorenzo River, Carbonera Creek, Lompico Creek, Shingle Mill Creek and The San Lorenzo River Lagoon (see **Error! Reference source not found.**). The specific water quality objectives that apply wholly, or in part, to sediment are contained within the Central Coast Region's Water Quality Control Plan (Basin Plan) (Carpenter, 1994, pg. III-3) and are listed below:

Settleable solids: Waters shall not contain settleable material in concentrations that result in deposition of material that causes nuisance or adversely affects beneficial uses.

Sediment: The suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses.

Turbidity: Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses.

Increase in turbidity attributable to controllable water quality factors shall not exceed the following limits:

1. Where natural turbidity is between 0 and 50 Jackson Turbidity Units (JTU), increases shall not exceed 20 percent.

2. Where natural turbidity is between 50 and 100 JTU, increases shall not exceed 10 JTU.

3. Where natural turbidity is greater than 100 JTU, increases shall not exceed 10 percent.

Allowable zones of dilution within which higher concentrations will be tolerated will be defined for each discharge in discharge permits.

Beneficial Uses

Designated beneficial uses for the San Lorenzo Watershed are listed in Table 1. Those beneficial uses that may be impacted by excessive sediment and/or turbidity include:

1. Cold Fresh Water Habitat (COLD) - Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish or wildlife, including invertebrates.

2. Migration of Aquatic Organisms (MIGR) - Uses of water that support habitats necessary for migration or other temporary activities by aquatic organisms, such as anadromous fish.

3. Spawning, Reproduction, and/or Early Development (SPWN) - Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish.

4. Rare, Threatened, or Endangered Species (RARE) - Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened, or endangered.

5. Municipal and Domestic Supply (MUN) - Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply. According to State Board Resolution No. 88-63, "Sources of Drinking Water Policy" all surface waters are considered suitable, or potentially suitable, for municipal or domestic water supply except where:

   a. TDS exceeds 3000 mg/l (5000 uS/cm electrical conductivity);
   b. Contamination exists, that cannot reasonably be treated for domestic use;
   c. The source is not sufficient to supply an average sustained yield of 200 gallons per day;
   d. The water is in collection or treatment systems of municipal or industrial wastewaters, process waters, mining wastewaters, or storm water runoff; and
   e. The water is in systems for conveying or holding agricultural drainage waters.

Table 1
Designated Beneficial Uses for Listed Waterbodies within the San Lorenzo Watershed

Waterbody Names	MUN	AGR	IND	GWR	REC1	REC2	WILD	COLD	MIGR	SPWN	BIOL	RARE	EST	FRESH	COMM	SHELL
San Lorenzo River Estuary					X	X	X	X	X	X	X	X	X		X	X
San Lorenzo River	X	X	X	X	X	X	X	X	X	X	X	X		X	X	
Carbonera Creek	X	X	X	X	X	X	X	X	X	X					X	
Lompico Creek	X	X		X	X	X	X	X	X	X					X	
Shingle Mill Creek	X			X	X	X	X	X	X	X					X	

Impacts to Beneficial Uses

Fisheries (COLD, MIGR, SPWN, RARE)

Anadromous fisheries are impacted by sediment within the San Lorenzo River Watershed. The San Lorenzo River and its three listed waterbodies, Carbonera Creek, Lompico Creek and Shingle Mill Creek have been identified as impaired by sediment due to impacts to beneficial uses associated with anadromous fisheries.

Dramatic decreases in coho salmon (from 5,000 in 1960 to <100 in 1980) and steelhead (from 20,000 in 1964 to 750 in 1980) populations within the San Lorenzo River and its tributaries have been attributed to the loss of suitable habitat for spawning, rearing and

oversummering due to excessive sedimentation from the extensive road system, urban and suburban development and natural and man-induced landslides within the watershed. Current populations of steelhead remain at early 1980 levels, while no coho salmon were found during 1994-1997 monitoring efforts (Alley, 1998, pg. 10-11).

Decreases in fish populations have often been attributed to the loss of stream habitat resulting from excessive sedimentation (SCCPD, 1979, pg. 71). "The San Lorenzo River once held the distinction of having the largest steelhead fishery south of San Francisco (SCCPD, 1979, secondary reference). The Department of Public Health (1950-1951, secondary reference) said 'The San Lorenzo River System is vitally important to the fisheries of the State of California,' with 100 miles of streams supporting fishery habitats. However, the watershed has experienced severe drops in both silver *(coho)* salmon and steelhead trout counts. In 1964, the number of steelhead in the San Lorenzo River was estimated at 20,000 (SCCPD, 1979, secondary reference). In 1980, that figure dropped to 750 (SWRCB, 1982, secondary reference). The salmon counts are equally discouraging. In 1960, the total salmon run was 5,000, but dropped to less than 100 by 1980 (SWRCB, 1982, secondary reference). Local groups have been stocking the river since the 1950's with 10,000 to 50,000 juvenile steelhead and silver salmon. Silver salmon stocking was discontinued in 1983 (U.S. Army Corps of Engineers, 1989, secondary reference)" (Jagger, 1993, pg 1-2).

On August 18, 1997, the National Marine Fisheries Service published a final rule listing the Central California Coast and South/Central California Coast steelhead Evolutionary Significant Units (ESUs) as threatened species under the Endangered Species Act. Numeric targets have been selected that are protective of steelhead and coho salmon habitat that are critical for spawning, rearing and overwintering.

"In 1962, Hee described all of the tributaries in the watershed as having either rocky or gravelly bottoms, which are ideal for the spawning of steelhead and salmon, with only the San Lorenzo River itself having sandy conditions (Hee, 1962, secondary reference). Sedimentation has destroyed more than 50 percent of ideal streambed habitat for steelhead and salmon in the years up to 1979 (SCCPD, 1979, secondary reference)" (Jagger, 1993, pg. 14).

"The severe drop in fish counts indicates that the habitat in the San Lorenzo Watershed is no longer compatible with the needs of the native fish species. While other factors may also contribute to the drop in steelhead trout and silver salmon, several sources have discovered a direct correlation between siltation and survival rates of steelhead and coho salmon fry (Shapovalov and Taft, 1954, secondary reference; SCCPD, 1979, secondary reference). Hee (1962, secondary reference) and the Santa Cruz County Planning Department (1979, secondary reference) have produced adequate descriptions of the watershed over the last thirty years to verify the fact that siltation is occurring" (Jagger, 1993, pg. 16).

Sedimentation problems have been associated with increased human activities in the watershed. "Prior to 1968, available literature refers to the pristine quality of the river and its attractiveness to tourists. Since 1968, various reports have documented the

general decline in the quality of the water within the San Lorenzo River and a concurrent decline in salmon and steelhead populations. Early studies indicate that the amount of sedimentation was a concern only in terms of quarry sluicing (Smith, 1958, secondary reference), and the turbidity of the water was measured only as it related to sewage outfall (Hee, 1962, secondary reference). Smith (1958, secondary reference) reported that sufficient scouring of streams in the watershed occurred during winter storms to offset the inflow of sediment from storm runoff. Leonard (1968, secondary reference) was the first to document a concern for the increased erosion caused by man's activities in the watershed. Sediment deposition has caused an increase in the amount of silt-covered bottom in the San Lorenzo River from 8 percent in 1966 to 65 percent in 1972 (SCCPD, 1979 analysis of Department of Fish and Game data, secondary reference). SCCPD (1979, secondary reference) analysis of USGS and county data revealed that, compared to expected natural rates, watershed streams have had very high rates of sediment transport. A 1990 study found that most tributaries of the watershed have been impacted by sediment from either development or unknown sources (SCS, 1990, secondary reference)" (Jagger, 1993, pg. 10).

The most recent study concerning sediment conditions in the San Lorenzo River was completed in July 1998 in support of the update of the 1979 San Lorenzo River Watershed Plan. The study findings are summarized below (Hecht, 1998, pg. 2):

"Stream conditions have not substantially improved since the 1979 Watershed Plan, despite the original plan's generally well-founded recommendations. The strongest comparative data are available for the Zayante and Bean Creek subwatersheds. In this portion of the watershed, the bed material is now composed of slightly finer bed material, with fewer clean spawning gravels or cobbles and boulders for summer rearing of young fish. The mineralogic composition of the bed sediment indicate that proportionately less bed sediment is originating from the upper portions of these watersheds, and more form the lower sandy portions. The upper areas are more typical of most areas of the watershed; this pattern suggests that existing measures may be helping slightly or at least inhibiting further sedimentation, although this should be regarded as an inference rather than a finding due to complicating factors. The lower portions of the two watersheds include large areas of urbanizing and eroding sandy soils, pointing to the need to address the unique challenges posed by these soils."

San Lorenzo River Lagoon

"The San Lorenzo River Lagoon comprises the reach from Monterey Bay at the Santa Cruz Boardwalk amusement park to the north of Water Street. Predominantly freshwater conditions occur upstream of Water Street while brackish water dominates the environment downstream of the pedestrian bridge. This estuarine zonation is reflected by the distribution of vegetation species on the channel bed and the lower levee and embankment slopes. In 1988, tule and cattail thrived in the brackish water conditions downstream of the pedestrian bridge, while freshwater species such as willow and alder were excluded and absent. Upstream of the brackish water zone, above Water Street, willow and alder grow on the channel bed.

"During winter months, the river mouth is opened by winter floods and the lower river is subject to tidal exchange to a high tide elevation of up to about 4.0 feet above mean sea level (msl). In the summer months, the combined effect of declining river flows and a build up of sand on the beach by summer wave conditions closes the river mouth with a sand bar. With the river mouth blocked, the lagoon fills up to elevations of 5.0 to 6.0, and occasionally up to 8.0 feet above mean sea level with freshwater supplied by inflows on the San Lorenzo River and Branciforte Creek. Because high lagoon levels have created flooding problems for the surrounding urban areas, the lagoon has often been artificially drained by breaching the sand bar with a bulldozer, or by had if the sand bar is narrow.

"… The lagoon is most productive when it is either entirely freshwater, as in the summer after the mouth has closed and freshwater inflows have displaced residual salt water, or when the water column is a well-mixed combination of salt and fresh water, typically in the winter months when the river mouth is open to tidal circulation. The lagoon habitat is not productive if it is static and stratified with a denser layer of salt water underlying a less-dense layer of fresh water. Stratification occurs either in the early summer months shortly after closure of the river mouth prior to conversion to freshwater, or when the lagoon has been artificially opened by breaching. When the lagoon is stratified and static, the bottom salt water layer acts as a solar collector which traps heat, raising water temperatures above levels where steelhead and their food (mostly aquatic species dependent on the environment of the lagoon bottom) can survive. In a prolonged stratified condition, steelhead are forced to the cool surface water where little food exists and where they become highly visible and easy prey for birds. Stratified conditions can also result in poor dissolved oxygen levels in bottom waters which degrade or destroy habitat for steelhead and their food.

"Breaching the sand bar to drain the lagoon in the summer months prolongs the stratified condition and damages the important steelhead habitat by introducing salt water and releasing freshwater. Breaching in the late summer months can be particularly severe because freshwater inflows to the lagoon decline, offering little chance to convert the lagoon to freshwater.

"During the summers of 1987 and 1988, a preliminary investigation of habitat changes was conducted. During this period, sand bar breaching was limited, and at times, the lagoon was allowed to fill up to 6.5 feet above msl. Without breaching, the summer lagoon converted to purely freshwater and provided good quality habitat. It extended upstream of Water Street with higher quality aquatic habitats from Water Street to the Ocean: adult steelhead were found in pools along San Lorenzo Park, juvenile steelhead found improved habitat throughout, and more vegetation along the lagoon fringes brought greater food productivity drawing greater numbers of waterfowl. When breaching was conducted several time in the summer of 1988, the water quality conditions declined and the fish population in the lagoon declined dramatically" (Philip Williams & Associates, et al, 1989).

The only written statement that was found that implicated sediment as the source of the temperature, dissolved oxygen and salinity problems in the lagoon were from an internal memo of the Department of Fish and Game (DFG) that assessed the coho salmon habitat in

San Mateo and Santa Cruz Counties. "Degradation of water quality in the lagoon from silt loading which creates shallow depths, and problems with DO, temperature and salinity" (Anderson and Nelson, 1996, pg. 15).

Although the Lagoon Management Plan and the DFG memo identify changes in temperature, dissolved oxygen and salinity as the physical properties affecting the fish habitat, they arrive at different conclusions on the causes of those changes. The Lagoon Management Plan builds a plausible case for the observed problems within the lagoon and decisions made within this TMDL are based on the management plan and not DFGs observations, which are generic in nature (Jennifer Nelson, 2001, personal communication).

The proposal to delist the San Lorenxo River (SLR) Lagoon is based on the fact that the original listing appears to have been based on generic data that was not truly indicative of the conditions in the SLR Lagoon. The City of Santa Cruz's 1989 study of the lower San Lorenzo River (Philip Williams & Associates, et al, 1989), which includes the Lagoon Management Plan, has established that problems within the lagoon are associated with the breaching of the sand bar that becomes established between the lagoon and Monterey Bay, and are not due to the delivery of sediment from upstream sources.

Based on the analysis provided in the Lagoon Management Plan, the lagoon is not significantly impacted by sediment delivered from upstream sources. Therefore, it is proposed remove the San Lorenzo Lagoon from the list of impaired waterbodies (303(d) list).

Municipal Water Supply (MUN)

The municipal water supply of the San Lorenzo Valley is dependent on the water quality of the San Lorenzo River and has been adversely affected by sediment. County residents rely on either the surface or ground waters of the San Lorenzo Watershed for their water needs. There are numerous surface water diversions within the San Lorenzo River Watershed that are used municipal water supply. Please refer to **Error! Reference source not found.**, in Appendix C: Color Figures, for a map display of the Municipal Water Supplies within the watershed.

During high flows, surface water diversions for municipal water supplies within the San Lorenzo River and its tributaries have experienced periods where they must be shut down due to excessive turbidity and sedimentation that overwhelm the filtering capacity of the intake facilities. This causes suppliers to rely on other sources at a time when available surface water is at its greatest quantity.

Currently, the impacts to municipal water supply are not clearly defined in terms of frequency and duration. There are no comprehensive records relating water supply operations to turbidity levels in the river and its tributaries. City of Santa Cruz personnel indicate that there may be a sliding scale on when intakes have be closed and can be opened depending on river and meteorological conditions. For example, if turbidity is at 10 NTUs and there is a threat of rain the City may decide to shut down the intake in anticipation of

increasing turbidity in the river if it does rain. If a storm has passed, the City may elect to open the intake when turbidity is at 25 NTUs in anticipation of decreasing turbidity as flow decreases after the storm.

There is an impression that turbidity impacts are getting "worse". A complete review of the City's operations log for the water intake may shed some light on the trends in turbidity levels and how they affect the City's operations. Other issues that may affect the operations of the water supply system for the City is an aging plant with increasing demands for water and stiffer requirements for turbidity on the delivery side of the system. The stiffer turbidity requirements on the delivery side are associated with pathogens and disinfection requirements for drinking water.

Also, turbidity is not strictly a sediment problem, especially in a watershed that has logging activities in it. Organic matter may be a significant component in turbidity levels.

The implementation of the recommendations of this TMDL for sediment reduction will also improve turbidity, in the long run. There are no quick fixes and it is felt that decreases in sediment delivery to streams will occur over many years, so operational considerations will have to assume that turbidity will not be improved in the short-term.

It is recommended that turbidity be monitored and its sources be identified as part of the Implementation and Monitoring Plan. As the issue comes into focus, numeric targets and allocations will be put in place, if warranted.

Conclusions

The San Lorenzo River and its tributaries, Carbonera Creek, Lompico Creek and Shingle Mill Creek exceed narrative water quality objectives for settleable materials because beneficial uses associated with anadromous fisheries have been adversely impacted by sediment.

The main impacts from sediment are to anadromous fish habitat: spawning gravels, pools and riffles. Fine sediments in spawning gravels can affect the survival of eggs by limiting flow through the gravels, thereby reducing oxygen supply to the eggs and interfering with the removal of metabolic wastes. Fine sediment in spawning gravels can also affect survival of fry by inhibiting their emergence from the redd. Pools that are used for oversummering habitat may become filled with fine sediment, reducing their volume, which in turn affects their overall usefulness. Riffles act as a source of food for fish by providing habitat for benthic invertebrates (water insects that live on the river/stream bottom) on which the fish feed. Sediment can reduce or eliminate habitat for benthic invertebrates by partially or completely covering riffles.

The San Lorenzo River Lagoon is not impacted by sediment. Increased temperatures, decreased dissolved oxygen levels and increased salinity have been associated with the breaching of the sand bar at the mouth of the river during summer, which was a management technique used to alleviate flooding to areas adjacent to the lagoon. The sand

bar forms during the summer due to wave action on the ocean side and decreased flows within the river. Because no direct impact to the lagoon from sediment could be identified, it is

Turbidity has been identified as a potential problem within the watershed. Specifically, municipal water supplies have had to temporarily close certain intakes due to periodic high turbidities. Most of the information surrounding the turbidity problems is anecdotal, with little specific data to establish the extent and magnitude of the impacts. Although it is recognized that turbidity does have an impact on the operation of some municipal water supplies, it is unclear what the operational parameters are that cause the closure of the intakes and the source of the turbidity has not been established. The City of Santa Cruz Public Works Department has installed a turbidimeter at the Tait Street intake in order to better define the turbidity problem. Turbidity monitoring throughout the watershed will be part of the implementation and monitoring phase of the TMDL in order to better define the impacts as well as the sources of the turbidity.

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